Prioritized Technology:
Instruments to Identify Biomarkers from Ocean Worlds

Technical Goals

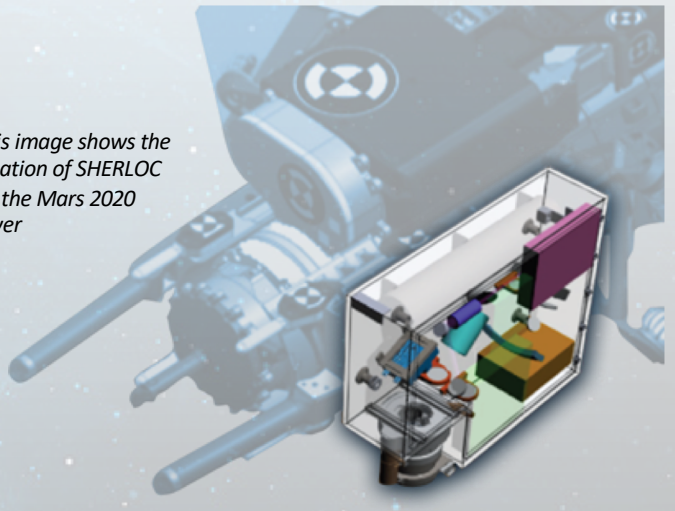
- Detect and characterize **<10 fmol** of biomarkers up to **10^4 Da** in a volume **< 100 µL**.
- Quantify enantiomeric excess with accuracy **≤ 5%** in **pmol** samples.
- Map organic molecules composition to **< 25 µm** spatial resolution.
- Sequence polymers with non-random repeating patterns with **>90%** accuracy.

Technical Status/ SOA

- Mars 2020 SHERLOC (Raman; 50 µm spatial resolution); ExoMars RLS (Raman Laser Spectrometer; 50 µm spatial resolution)
- MSL/SAM by evolved gas analysis, derivatization-GCMS; ExoMars/MOMA by derivatization-GCMS; limit of detection 10 ppbw); MatISSE-funded LITMS; COLDTech-funded EMILI (ion trap mass spectrometers with GCMS)
- ExoMars/MicrOmega IR spectrometer (25 µm spatial resolution)
- Rosetta/COSIMA (secondary ion mass spectrometer; spatial resolution 50 um); COSAC (GCMS)
- ASTID-funded AOTF IR point reflectance spectrometer (capable of integration with LD-TOF-MS)
- COLDTechEnceladus Organics Analyzer
- SOLID/ExoMars(descoped): fluidic analyzer, 1-2 ppb biopolymers; 103spores/mL (based on Earth biology)
- •OASIS LCM
- MINION/ISS: fluid phase; read accuracy ≥ 65%
- MatISSE'14: Search for Extraterrestrial Genomes
- MatISSE16: Enceladus Orbiting Sequencer

Mission Applications

- Identification of biomarkers similar to terrestrial, particularly in racemic excess, would be a strong indicator of habitability.
- Non-random patterns of molecular mass or non-equilibrium isomeric ratios could be an indicator of metabolic activity.



This image shows the location of SHERLOC on the Mars 2020 rover

9/20/17